

Process Safety Indicators Key to Incident Free Operation

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Process Safety Management Seminar

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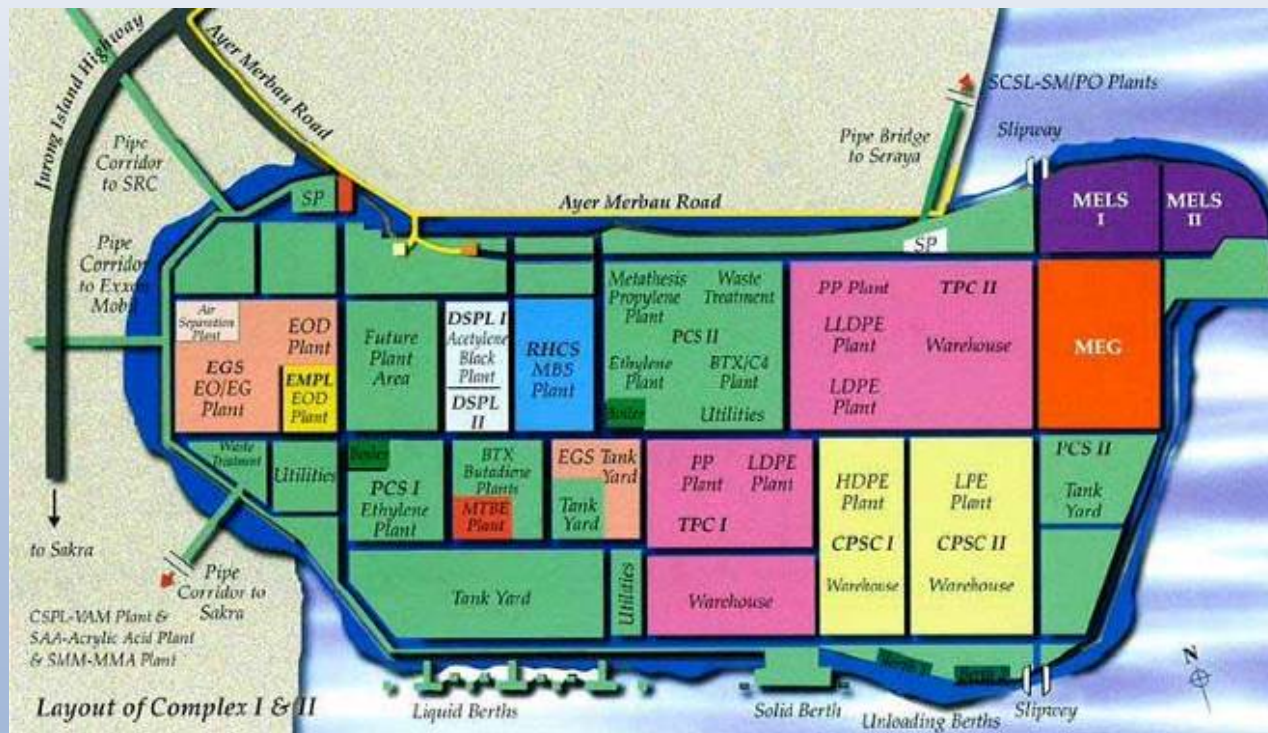


Introduction to PCS

- upstream company of Singapore Petrochemical Complex on Jurong Island
 - supply high quality ethylene, propylene, acetylene, butadiene, 1-butene, MTBE and benzene to companies mainly within Island
- 1984 – first full-fledged ethylene plant (cracker) in Southeast Asia on stream
- 1997 – second world-scale unit on stream
- present shareholders – Japan-Singapore Petrochemicals Co., Ltd (50%) and QPI and Shell Petrochemicals (Singapore) Pte. Ltd. (50%)



Singapore Petrochemical Complex



Health, Safety & Environment achievements

- ISO 14001 certified since Jan 2000
(Environmental Management System)
- OHSAS 18001 certified since Nov 2002
(Occupational Health & Safety Management System)
- first enterprise to achieve certification to Singapore Standard SS 506 Part 3 in Dec 2009
(amalgamation of Process Safety and OHS elements)
- WSH Performance (Excellence) Award recipient – 2011



Health, Safety & Environment achievements

- Responsible Care signatory since Oct 1999
- bizSAFE Partner since 2008
- bizSAFE Mentor in 2011
- WSH Advocate in 2011



SAC accredited Inspection Body (Type B) since 2009 (first to be accredited)

- equipment inspection; integrity assessment
- process equipment integrity → process safety
- environmental impact, personal safety



Once there was a very large chemical company, one of the largest on the planet.

Known for its attention to detail, its competitors considered it well above average in process safety practice and performance. One year, one of its facilities in a developing country developed a catastrophic leak, releasing a deadly gas; thousands of the surrounding populace were killed or injured by this gas.

(Alexander & Stoler, 1984)



Presentation Outline

- Process Safety - what, why
- Business Commitment, Benefits
- Why Process Safety ?
- Initiatives
- Why measure performance ?
- Selection, typical Indicators
- Learnings from PS incidents
- Learning / Sharing cycle
- Way forward

Process Safety

- What
 - engineering and management skills focused on preventing catastrophic accidents, associated with use of chemicals
 - appropriate process technologies to manage hazards of chemical plant (processing activities) by elimination / control
 - process safety incidents are “high consequence, low frequency” events
- Why
 - impact of incidents helped shape approach to process safety
 - raise awareness in design and operation
 - disseminate lessons learnt; help prevent similar incident



Business Commitment

- process safety risks are real risks to any business; good performance represents good value
- recognise importance of process safety and encourage continuous improvement
- commitment
 - actively manage process safety
 - engage with workforce
 - monitor performance
 - share best practice
 - learn from relevant incidents across industry sectors

Benefits

Qualitative

- Corporate Responsibility – care about employees and community
 - best insurance policy for protecting company reputation and shareholder value
 - engage employees by increasing morale, loyalty, retention
 - help regulators understand facility's credibility and unique considerations
- Business Flexibility – earn through trust
 - strengthen and maintain good relationships with community and regulators
 - attract, retain high performance staff
 - obtain regulatory approvals more quickly



Benefits

Quantitative

- Risk Reduction – reduced risk exposure
 - reduce risk of catastrophic events
 - prevent likelihood of human injury, environmental damage and associated costs
 - reduce business interruptions
- Sustained Value – increased productivity, reduced costs
 - improve reliability, mechanical integrity of equipment
 - identify and address safety, operability and reliability issues before they occur
 - extend interval between major turnarounds and reduce turnaround time

Industry issues

- How does one company's process safety performance compare to others ?
- Is a company headed for a major accident ?
- Is the company improving its process safety performance ?

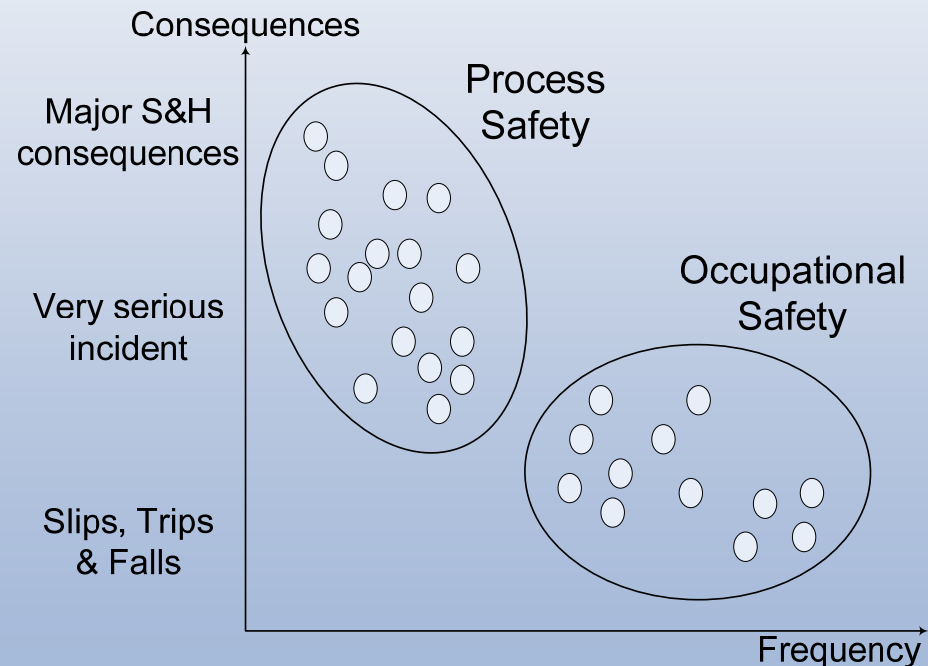
- many companies have process safety performance indicator programs
 - differ from organization to organization
 - indicators not “perfect”
 - no single authority / institution has established set of common indicators

Personal vs Process Safety

- must be clear about distinction between personal and process safety
- distinction between different types of hazards
 - process safety hazards are those arising from processing activity
 - personal safety hazards affect individuals but have little to do with processing activity

Why Process Safety ?

- personal (or occupational) safety characterized by low consequence / high frequency incidents
- often, focus too much effort on occupational safety
- process safety deserves more attention
 - commensurate with risk
 - pro-active, centers on safety integrity of process(personal safety focuses on injuries – reactive focus)



Initiatives

management leadership and visibility with clear process safety management system and improvement plan

- leadership from top management level, discussing process safety in board meetings
- visibility and visible commitment of top management, through site visits and open dialogues
- enhancing engineered and administrative safeguards that act to achieve or maintain a safe state of process
- implementing an integrated set of leading and lagging performance indicators, which are periodically updated
- reviewing industry incidents and recommendations across major hazard sectors for learning lessons and improvement

Reliability

- equally important
 - safety and operational reliability closely linked
 - process hazards greater during transient or emergency operation due to unreliability
- mechanical integrity program an essential element in OSHA PSM standard
- approach to evaluating equipment failure risk can be used to determine reliability needed to prevent process safety consequences
- develop / track Reliability Indicators

Why measure performance ?

- reduce risks
- accident early warning system
- increase awareness of safety, health and environment issues
- means for checking whether goals are being met / realistic
- basis for deciding on allocation of safety-related resources

Performance indicators

- **Operational control indicators** monitor actual process control
 - critical operator actions / procedures
 - control and instrumentation systems trips / alarm
- **Risk control system indicators** monitor effectiveness of key parts of PSM / SMS
 - Management of Change
 - Permit-to-Work
 - plant maintenance
- **Program indicators**
 - % of plant inspections
 - % of safety audits completed on time

Measuring performance

- adopt leading and lagging indicators
- leading indicators – measure the effectiveness of preventive and control measures
- lagging indicators – measure incidents or failures that have happened
- tool for safety management system
 - information on safety problems
 - support policy development and priority setting
 - develop action plans
 - monitor effects of policy responses



Lagging indicators

- OUTCOME measure
 - measure and learn from incidents that have occurred
 - reactive measure of some aspect that has failed
 - (at least) a layer of protection of process safety system has actually failed
- however minor, important to be investigated and recorded
 - trends recorded; indication of larger systemic failure
- indicators show when desired safety outcome has failed, or not been achieved



Leading indicators

- Performance DRIVER
 - provide early warning of possible incident occurring
 - measure effectiveness of controls and provide assurance that systems designed to control risks are operating as intended
 - proactive measure of performance of key process or system
- leading indicators considered "drivers" of lagging indicators
 - improved performance in leading indicator will drive better performance in lagging indicator
- when measured and monitored effectively, leading indicators provide data to enable effective intervention

Selection criteria

- easy to understand and relevant; drive process safety performance improvement and learning
- normative (possibility to compare to baseline)
- sound and statistically valid (consistent definition, data set size)
- responsive to change in time and space
- technically feasible, cost-efficient (data collection)
- useable for scenarios for future projections
- SMART test
 - Sufficient, Measurable, Accurate, Reliable, Targeted
- *10 is a good number*

Process Safety Indicators

Some examples

- lagging indicators
 - no. of fire incident
 - no. of loss containment, spill or release incident
 - no. of safety valve lifting incident
 - no. of equipment or piping failure
 - no. of process upset

Process Safety Indicators

Some examples

- leading indicators
 - no. of Near Misses
 - no. of temporary repairs (deferred maintenance items) currently in service
 - % of backlog of MoC documents (not closed)
 - no. of special operating procedures developed
 - no. of requests made to bypass critical interlocks
 - no. of Alarm Activation (near design envelope)
 - no. of Interlock Sequence Activation (design envelope protection)

Learnings from PS incidents

- accidents continue to happen
 - learn from our own mistakes ?
 - NOT learning from those made by others !
 - “will not happen here” attitude ?
- two categories of unawareness / lack of knowledge
 - knowing that you don't know
 - not knowing that you don't know
- learning from experience of others
 - valued, relatively painless process
 - essential tool; without going through actual incident
- review lessons learnt, evaluate and close gaps





Marathon Oil

Bhopal

Flixborough



BP Texas City

Buncefield



Exxon Valdez



Piper Alpha



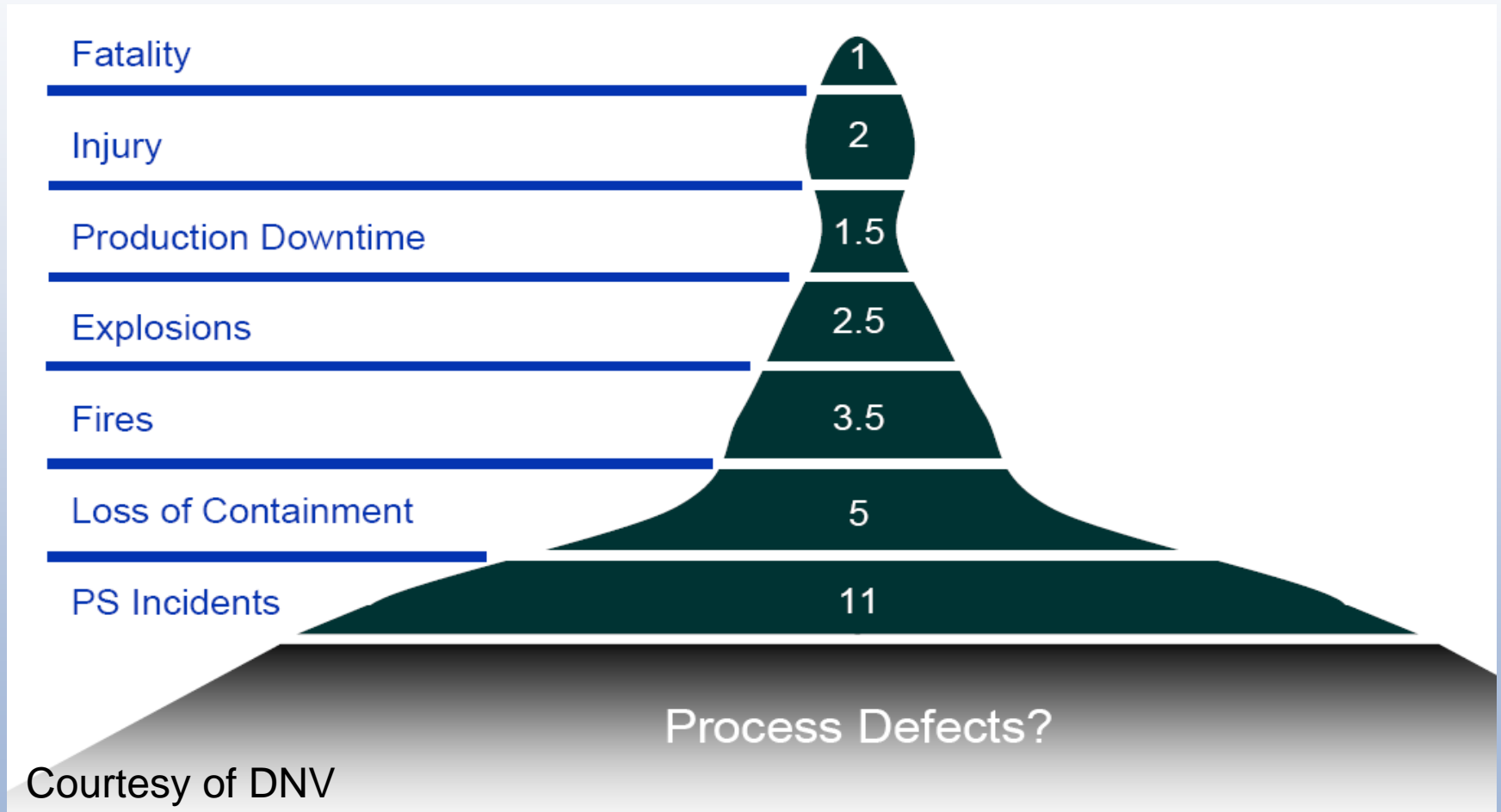
BP Grangemouth



Deepwater Horizon



Process Safety Incident Ratio



Key Learnings from PS incidents

Buncefield

- review/amend management systems for maintenance of equipment and systems to ensure their continuing integrity in operation
- system of leading and lagging performance indicators for process safety performance
- measures to detect hazardous conditions arising from loss of primary containment
- good practices, incorporating experience from other high hazard sectors, shared openly

IOC Jaipur

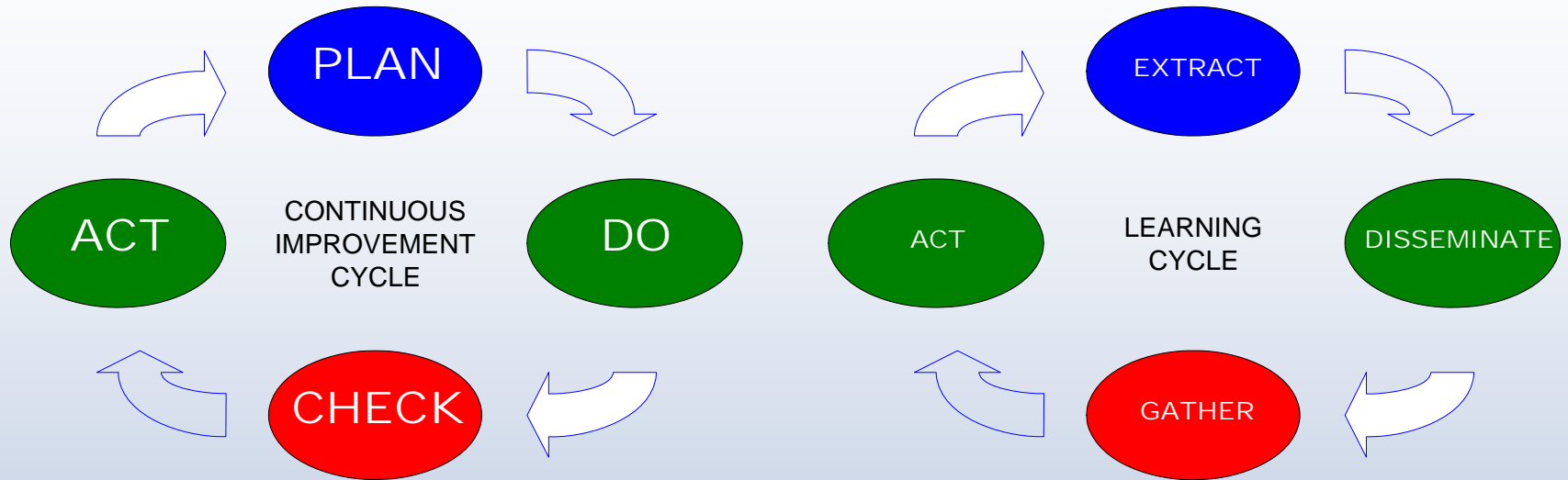
- supervision for pipeline transfer line up and operation
- SOPs to include know why
- hydrocarbon detectors near potential leak sources
- implement Near Miss Reporting system, Management of Change system

A moment to ponder ...

- look back to 1984... *chemical industry developed policies and procedures to ensure that such a tragedy that struck Bhopal never occurred again*
- 2011... *process safety incidents continue at all levels of tragedy*
- create an environment of mutual learning; share process safety concerns
 - approach will not only prevent known hazards, but help to anticipate and respond to unidentified risks



Learning cycle



- **Extract** learnings
- **Disseminate** learnings
 - external loop – to learn, to share what they learnt
- **Gather** learnings
 - lessons must be personalised
- **Act** on learnings

Way forward

- review PS Indicators regularly
 - act on “disturbing” trend
 - CCPS* recommends use for 2-3 years to establish base of experience before considering improvements; expect to take 3-5 years to fully implement effective indicators
- creating process safety moments
 - raise awareness
 - begin meetings with brief “safety moment” – safety share, reinforcement of Management commitment, CCPS “PS Beacon”, etc
- effective learning from case histories
 - **What, Why, Where**
 - **What Went Wrong**

* Center for Chemical Process Safety



Leadership commitment

Talk the Talk

Walk the Talk

Ensure environment where all
can Talk and Walk the Talk

- explore and challenge deeply-held beliefs, values, etc
- thoughtful conversation and active listening



Thank you

